

In the Specification:

On page 1, after the title insert the following:

#### **RELATED APPLICATIONS**

This is a U.S. national stage of International Application No. PCT/EP2005/000500, filed on January 19, 2005.

This patent application claims the priority of German patent application no. 10 2004 013 478.2. filed March 18, 2004, the disclosure content of which is hereby incorporated by reference.

#### **FIELD OF THE INVENTION**

On page 1, before line 12, insert the following heading:

#### **BACKGROUND OF THE INVENTION**

On page 1, before line 35, insert the following heading:

#### **SUMMARY OF THE INVENTION**

On page 2, delete the paragraph beginning on line 4 through line 7 in its entirety.

On page 2, before line 9, insert the following:

This and other objects are attained in accordance with one aspect of the invention directed to a method for the production of a bipolar transistor comprising a highly doped extrinsic base. The method comprises providing a base layer on a semiconductor substrate, depositing a dielectric layer in weakly doped or undoped fashion on the base layer, applying an implantation mask and patterning in such a way that an opening remains in a region provided for a later extrinsic base, introducing a dopant of a first conductivity type into the dielectric layer after the application of the mask, using  $\text{BF}_2$  as the dopant and indiffusing, in a controlled thermal step, the dopant into the semiconductor substrate from the dielectric layer, an extrinsic base doped in low-resistance fashion arising.

On page 2, amend the paragraph beginning on line 27 as follows:

According to an embodiment of the invention, however, the dielectric layer is not doped until after the deposition. This makes it possible to introduce a high dopant dose into the dielectric layer, and the thickness of said layer can be kept small. From a thin dopant-containing layer, in turn, the dopant can be outdiffused into the base layer in a much more controlled manner than from a thicker layer. In the case of the latter, the boundaries of the doping zone thus produced in the base layer would be more diffuse and the extent of the doping zone would be more difficult to control.

On page 3, amend the paragraph beginning on line 9 as follows:

The transistor produced according to an embodiment of the invention is preferably formed as an npn bipolar transistor. This means that the base layer just like the dielectric layer is p-doped, or that the dopant of the first conductivity type may produce a p-type doping, whereas the dopant of the second conductivity type may produce an n-type doping.

On page 8, delete the paragraph beginning on line 27 through line 32 in its entirety.

On page 8, before line 34, insert the following heading:

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

On page 9, before line 4, insert the following heading:

#### **DETAILED DESCRIPTION OF THE DRAWINGS**

On page 9, amend the paragraph beginning on line 21 as follows:

Figure 1 shows the arrangement after the definition of the transistor regions. At this stage a conductive connection to the collector connection zone can also be created outside the active transistor zone by ~~means of~~ a doping technique referred to as a sinker. With this technique, a dopant is introduced into a semiconductor body at a first depth. By diffusing the dopant down until it reaches a second depth, the volume of the doped region can be enhanced such that the doping reaches a desired region at the second depth. In the invention, the sinker can be used to create an electrically conductive connection from the surface of the semiconductor body to the

collector formed as a buried layer at the second depth. The collector connection KA shown in Figure 7 can be produced by a sinker

On page 10, amend the paragraph beginning on line 4 as follows:

Figure 2 shows a variant of the method in which at least one electrically insulating intermediate layer ZS is additionally applied over the semiconductor wafer prior to the growth of the base layer BS. The purpose of the intermediate layer can be to define a step on top of the semiconductor wafer for helping to differentiate between the extrinsic base and transistor region TB during epitaxial deposition of the base layer. Further, the intermediate layer can provide a desired surface material or surface property different from that of the oxide regions OB. The intermediate layer is patterned in such a way that at least the transistor region TB remains uncovered. On account of the varying crystal modification and the intermediate layer possibly present, corresponding steps can form in the base layer. Figure 2 shows the arrangement after this method step.

On page 10, amend the paragraph beginning on line 19 as follows:

In accordance with one variant, the dielectric layer DS is subsequent patterned and an emitter window EF is opened in the process. Over that an emitter layer heavily doped with a dopant of the second conductivity type, and in particular with arsenic, is then applied over the whole area. Preferably, a further layer of a dielectric, and in particular an oxide layer, is produced over that ~~and the~~ to help structure the emitter layer thereby preventing the emitter from getting doped or damaged during implantation of dopants into the dielectric layer DS. The

emitter layer is subsequently patterned with the aid of a photoresist mask, the desired emitter E remaining. However, the latter is not identical with the later electrically active emitter located in the crystalline zone of the base layer after diffusion. Figure 4 shows the arrangement after this method stage. A diffusion process drives dopants out of the emitter into the base layer such the "electrically active emitter" is not exactly at the boundary between emitter layer and base layer, but is in the base layer near that boundary. The electrically active emitter is at or near the semiconductor junction between emitter and base which is labelled EBU in Figure 7. Because of diffusion, EBU is spaced from the layer interface.

On page 12, amend the paragraph beginning on line 8 as follows:

As a result of the entire diffusion operation, the base layer is highly doped and thus acquires low resistance in the region of the extrinsic base EB. The intrinsic base IB, which provides the actual base function in the bipolar transistor, is left in the remaining predominantly monocrystalline region of the base layer BS. The intrinsic (active) base IB is electrically connected via the extrinsic base EB, which, as a result of the high doping, ensures a high conductivity and thus a low-resistance base terminal. Between the active base, which strictly is defined by the emitter-base junction, and the extrinsic base EB there remains a safety clearance that is minimized in the method according to the invention. While the active base needs a low doping concentration to guarantee good electrical transistor properties the extrinsic base has to be doped very high to minimize its resistance. Thus, a given distance (safety clearance) has to be maintained between the active base and the extrinsic base such that the active base is not deteriorated by dopants from the extrinsic base. As this distance (safety clearance) has a doping concentration smaller than that of the extrinsic base, it has a higher resistance that forms the

major part of the total resistance of the base terminal. By reducing the length of the safety clearance the total resistance of the base terminal can be reduced and the switching speed and switching frequency of the transistor can be enhanced.

On page 14, after line 16, insert the following paragraph:

The scope of protection of the invention is not limited to the examples given hereinabove. The invention is embodied in each novel characteristic and each combination of characteristics, which includes every combination of any features which are stated in the claims, even if this combination of features is not explicitly stated in the claims.